Pasture/Hay Fields

Pasture/Hay Field

[Existing conditions inventory maps and photographs follow this section]

Introduction

This landscape is generally characterized by the low-lying land located on either side of the Clark Fork River floodplain which is irrigated for hay production and grazing. It also includes the pasture land found in Front Field, which is located north of the Warren Hereford Ranch complex and along the eastern boundary of the ranch.

Natural Systems and Features

[see Map EC-19,20 at the end of this section]

This land is gently rolling to flat topography. Tetonview loams are found on the meadow land and hay fields found on either side of the river's floodplain, primarily on the east side where the lands have been cultivated with hay. These soils, as well as the Varney-Clay loams found in the western lower meadows, are very deep and poorly drained. The pasture located within Front Field contains a combination of Beaverell and Cetrack loams, which are very deep and well drained soils.[1]

Spring Gulch, also referred to as Spring Creek, feeds into the now abandoned Warren Ditch located in the northwest corner of the Ranch (currently the Olson land easement) before joining the Clark Fork River further to the north. Two unnamed gulches, one on the east, which feeds into the Kohrs-Manning Ditch near the Warren Pump (HS-86), (see Photo 3-5-1), and one on the west, which feeds into the Kohrs "Big" Ditch in the middle of the ranch also support the irrigation of the fields. The spring-fed No Name Creek is located within the pasture/hay field located east of the Clark Fork riparian woodland. It serves as a tributary to the Clark Fork River.

Vegetation

[see Map EC-19,20 at the end of this section]

The major grasses found in the irrigated hay fields and meadows along the riparian zone are smooth brome (*Bromus inermis*), common timothy (*Phleum partense*), Kentucky bluegrass (*Poa pratensis*), red clover (*Trifolium pretense*), Canada thistle (*Cirsium arvense*), crested wheatgrass (*Agropyron cristatum*), and white clover (*Trifolium repens*), (see Photo 3-5-2). All these species are exotic.[2] The Lower Yard Field and North Meadows area, in between the Kohrs-Manning Ditch and the Riparian Woodland, is a mix of riparian and dry upland grasses.[3] Bebb and slender willows, along with occasional black cottonwoods and river birch, are particularly found along the irrigation ditches, natural springs, and sloughs.

The most abundant grasses found within the dry upland benches and non-irrigated pasture areas include bluebunch wheatgrass (*Agropyron spicatum*), moss phlox (*Phlox muscoides*), needle-and-thread grass (*Stipa comata*), Missouri goldenrod (*Solidago missouriensis*), hairy goldenaster

[1] Natural Resource Conservation Service, *Soil Survey Geographic (SSURGO) and National Soils Information System (NASIS) Data* [electronic files online], Montana Natural Resource Information System, compiled 1995 (Accessed July 2002). Metadata available from World Wide Web: (http://nris.state.mt.us/nrcs/soils/).

[2] Species location information derived from Janet Hardin, "Plant Species & Locations, GRKO Database, Final Inventory" (Missoula: University of Montana, Division of Biological Sciences, June 3, 2003).

[3] Hardin.

(*Chrysopis villosa*), desert alyssum (*Alyssum desertorum*), and blue grama (*Bouteloua gracilis*).[4] Except for crested wheatgrass and desert alyssum (which are exotic), the rest of the species are native to the region.

The following species are also common to the non-irrigated upland benches: western wheatgrass (*Agropyron smithii*), crested wheatgrass (*Agropyron cristatum*), leafy musineon (*Musineon divaricatum*), scarlet gaura (*Gaura coccinea*), standing milkvetch (*Astragalus adsurgens*), plains reedgrass (*Calamagrostis montanensis*), prairie smoke (*Geum triflorum*), little-leaf alumroot (*Heuchera parvifolia*), spineless horsebrush (*Tetradymia canescens*), Bessey's locoweed (*Oxytropis besseyi*), winterfat (*Krascheninnikovia lanata*), and skeletonweed (*Lygodesmia juncea*).[5] All these species are native to the region.

Whereas the majority of abundant species found within the dry uplands and benches were observed in the 1983 Rice and Ray study, the eastern Front Fields and North Field, which are naturally dry but have been irrigated with water from the effluent ponds since the 1960s, are changing species composition from predominantly dry upland grasses (see above) to smooth brome and spotted knapweed, both exotic species, which are out-competing the native grasses.[6] These fields also contain less common species such as orchard grass (*Dactylis glomerata*) and western sticktight (*Lappula occidentalis*), the latter of which is an exotic species.[7]

Over the past few years, the park has been aggressively conducting a noxious weed program against Canadian thistle, leafy spurge, and spotted knapweed. These invasive exotic species threaten the ability of the ranch to produce certified weed-free hay for use in backcountry areas of other NPS units. These weeds also compromise the mission of the park to maintain the overall range condition of the land, and restore native grasses to the pastures. The weed control program consists of insect biological controls, herbicide spraying (the most common control method), as well as some hand pulling and mowing.[8] In 2002, the park sprayed over 160 acres of land, while achieving containment of 50.[9] The weed control program continues to present resource management challenges. The park will continue to try and reduce weed populations through monitoring and control programs.

Spatial Organization
[see Map EC-21,22 at the end of this section]

The spatial organization of the hay fields/meadows are generally defined by the vegetation of the riparian woodland, irrigation ditches, fences, and roads.

Stuart Field, which is approximately 32 acres, is located in the south central area of the ranch (see Photo 3-5-3). It is defined by riparian woodlands and jack leg fencing to the west and south, riparian woodlands, jack leg fencing, and the elevated railroad corridor to the east, and the main

[4] Hardin.
[5] Hardin.
[6] Hardin; Telephone interview with Janet Hardin, June 2, 2003.
[7] Hardin.
[8] Tony Schetzsle, "Technical Assistance Request-Integrated Pest Management," Grant-Kohrs Ranch National Historic Site, NPS Memorandum, (Grant-Kohrs Ranch National Historic Site, Deer Lodge, Montana, Central files, August 30, 1996).
[9] Darlene Koontz, "Narrative Report," Grant-Kohrs Ranch National Historic Site, NPS Memorandum highlighting management achievements during 2001-2002 (Grant-Kohrs Ranch National Historic Site, Deer Lodge, Montana, Central files, February 21, 2002).

east/west service road to the north. It is characterized by the hay grasses and contour irrigation ditches located within it.

The **Lower Yard Field** and **North Meadow** are located on the east side of the Clark Fork River, (see Photo 3-5-4). This 104 acre area is defined by the riparian woodland on the west, the Kohrs-Manning Ditch on the east, the west feedlots on the south, and the old sewage treatment pond to the north. This space is used primarily for grazing and is characterized mostly by the meadow grasses and the occasional willows and cottonwoods found along the ditch and spring-fed sloughs. The North Meadow is used for pasture, and can be irrigated with water from the Kohrs-Manning Ditch. Lower Yard Field is irrigated with water from the Kohrs-Manning Ditch and is cultivated for hay.

The **Front Fields** are located north of the Warren Hereford Ranch complex. This 100 acre area is bordered on the east by Business Loop 90 and on the west by the railroad corridor and barrow pits. The NHS boundary fence and Sewage Treatment Service Road forms the northern boundary of this area. Metal post and wire fences surround the whole area, and also subdivide the North Fields into four separate fields. This area is used for pasture and is irrigated via hand lines with effluent water from the sewage treatment ponds. This hand-line irrigation system was added by Warren in 1954 to irrigate planted crops (probably alfalfa), fell into disrepair, and was later rebuilt by NPS ca. 1999, using water from the treatment ponds.

As their name suggests, the **Western Hay Fields** (also known as Pumphouse Fields 1-4 and Lower Meadow Fields 1-4) are located in the lowland area on the western side of the Clark Fork River riparian area. They extend the entire length of the park, and are generally bounded on the west by the Kohrs "Big Ditch" Road. These fields are generally fenced with either wood or metal post and wire fencing. Some jack leg fencing is found along the southern edge of the riparian zone. These hay fields (213 acres total) are subdivided into four separate fields, each one irrigated with contour ditches that feed off of the Kohrs Ditch. The Kohrs ditch is supplemented with water pumped from the Clark Fork River.

L-Barn Field is located directly to the north of L-Barn Field South. Jack leg fencing, along with the Kohrs-Manning Ditch, defines this field's southern boundary. The eastern edge of this field is defined by the railroad corridor and barrow pits, and the Warren Pumphouse Road (which terminates along its northern border). This edge is reinforced by metal post and wire fencing. This 22 acre field can be irrigated via hand lines with water from the effluent field. **L-Barn Field North** is located directly to the north of L-Barn Field, in between the railroad barrow pit on the east, and the Kohrs-Manning ditch to the west. This long and narrow 11-acre field is primarily used for grazing.

The Olson property, located along the northern edge of the NHS, contains approximately 160 acres of land. Approximately 60 acres of this land falls within the riparian zone. **Olson Field West** is located west of the riparian area and backs up to the foothills. This land is cultivated for hay. Metal post and wire fencing, as well as the Kohrs Ditch Road, reinforces this western boundary. **Olson Field East** lies on the east side of the riparian zone. The Kohrs Manning Ditch flows along the eastern edge of this field. It too is primarily cultivated for hay. **Treatment Pond Field**, located directly east of the sewage treatment ponds and the Kohrs-Manning Ditch, is defined on the eastern side by the railroad corridor and barrow pit. This field is not irrigated. During the site visit in the fall of 2002, this field was being grazed by cattle. The sewage treatment pond access road divides this field from Olson Field East to the north. Its southern boundary is defined by the metal post and wire fencing separating it from the North Fields.

Land Use
[see Map EC-21,22 at the end of this section]

Approximately 224 acres of land within this component landscape are currently in pasture and used for grazing. The remaining 308 acres are used for hay production, which is typically harvested in the late summer. This number fluctuates annually (more irrigated fields can be used for grazing, if necessary), based upon the ranch's needs for hay and the number of cattle maintained on the land.

Constructed Water Features
[see Map EC-23,24 at the end of this section]

There are several constructed water features in the pasture/hay field which are used to irrigate the lands located in this area.

The **Kohrs-Manning Ditch** is located on the east side of the Clark Fork River (see Photo 3-5-1). It derives its water from the Clark Fork River, Johnson Creek, and an unnamed spring. It provides irrigation to Stuart Field, the South Pasture, and the Lower Yard Fields. Within the Lower Yard Field and North Meadow, a lateral, or secondary ditch of the Kohrs-Manning Ditch breaks off to the west to irrigate these areas.

The **Kohrs Ditch** (also known as "The Big Ditch"), is located on the west side of the Clark Fork River, and generally follows the ranch's western boundary (see Photo 3-5-5). It gets its water from both Taylor Creek and the Clark Fork River via pipe and pump, and provides irrigation to the Western Hay Fields that lay between it and the river.

The **Warren Ditch**, which is located along the far northwestern boundary of the ranch, derives its water from Spring Gulch. Based upon information provided by the park, this ditch is no longer in use.

The **Johnson Ditch**, which is located in Stuart Field, derives its water from Johnson Creek. It provides irrigation to Stuart Field before joining up with the Kohrs-Manning Ditch.

Constructed water features within the Pasture/Hay Field landscape area also include an **irrigation main line system with risers for the handline** used to provide effluent irrigation to Front Field and the southern section of North Field. There is also enough line to irrigate the large western pasture located in the East Feed Lot. All of the irrigation pipe in this area is completely removable, with the exception of the mainline, which has risers with valve opening elbows. These risers allow the NPS to open up the hand line for water and line extensions. This system, which was installed by the NPS in the mid-1990s, replaced the historic hand line irrigation system installed by Con Warren in 1954.[10]

The **effluent wells** located in this area monitor water quality from effluence application by the handline. The irrigation headgates are used for redirection of water on the fields and for secondary ditch use. The headgate that is located in the L-barn field is no longer in use. It was used for pooling to a pump station that ran the old irrigation system before the effluent system

[10] Grant-Kohrs Ranch National Historic Site, "Info on Hand Line," Portion of report prepared to describe impacts associated with installation of hand line system (On file at the Grant-Kohrs Ranch NHS archives, No date).

was installed. The line of pipe connecting to it is an abandoned line used in the old irrigation system and is no longer in use. [11]

An underground **irrigation pipe**, approximately 200 feet long, also takes up water that is pumped from the Clark Fork River (HS-87), and delivers it to the Kohrs Ditch further to the west.

Other irrigation hardware includes a variety of different types of head gates, distribution gates, diversion dams, and culverts. **Head gates** are typically comprised of either two concrete or wooden head walls that are constructed on the inside edges of the main ditch (see Photo 3-5-6 and Photo 3-5-7). Closing these headgates (typically with wooden gates), allows water to be distributed into the smaller lateral/secondary ditches. In other instances, small wooden gates or metal **distribution gates** (consisting of a hand knob that controls the elevation of the gate) control this distribution (see Photo 3-5-8). Some of these distribution gates have headwalls, while others do not. Although not all headgates and distribution gates were inventoried during the field visit, most of those observed appeared to be in fair condition. A few wooden gates were in need of repair.

Diversion dams, located every few hundred feet along the secondary ditches, are composed of rubber impregnated canvas (or a heavy rubber sheet in some cases) attached, as a manuscript is attached on a scroll, to sturdy poles, usually three to four inches in diameter. When flooding is desired in a given area the pole is placed across the ditch and the fabric dropped into the hole, the bottom held by any available nearby stones. The water then rises and spills over the edge or out of vents in the low berm along the ditch cut with a shovel. When not in use, the portable diversion dams are thrown alongside the ditch.[12]

Within the Grant-Kohrs Ranch NHS, there are approximately 100 **culverts** that have been placed to contain these ditches. These culverts are generally placed underground to allow roads to pass over them, while others have been constructed to allow ditches to pass over or under other water bodies. There are many different types of culverts, including those constructed of metal, wood, PVC, and concrete (Photo 3-5-9). These culverts vary in length from three to over 20 feet.[13]

Several beaver dams have been constructed within the pasture/hay fields area along the natural creeks and sloughs, as well the along the ditches. These animals, while native to the region and part of the natural ecosystem, pose hazards to the operability of the irrigation system. The construction of beaver dams may flood areas that historically were not flooded, creating different ecological conditions and plant community habitats than may be desired for ranch operations. Likewise, they may also prevent the legally mandated flow of water from passing through irrigation ditches to neighboring lands. Visual screening provided by the large cottonwoods is also threatened by beaver damage. As such, the NPS routinely issues special use permits to authorize the reduction of the beaver population through live trapping and relocation.[14]

Columbian ground squirrels also cause damage to the irrigation system. Poison grain baits have been used as a pest control measure with varied results.

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[11] Personal correspondence with Jesse Harris, Rancher, Grant-Kohrs Ranch NHS (February 2003).
[12] Albright, 157-158.
[13] National Park Service, *Culverts at Grant-Kohrs Ranch National Historic Site, Montana* [electronic file online]. Grant-Kohrs Ranch NHS GIS Program, compiled 1998 (Accessed 16 September 2002). Metadata available from World Wide Web: (http://www.nps.gov/gis/metadata/grko/grko_culvert.html).
[14] Tony Schetzsle, "Beaver Population Reduction," Grant-Kohrs Ranch National Historic Site, Email authorizing special use permit (Grant-Kohrs Ranch National Historic Site, Deer Lodge, Montana, Central files, February 3, 1999).

Circulation
[see Map EC-21,22 at the end of this section]

There are three primary north-south roads located within the pasture/hay field landscape areas. These include the **Kohrs Ditch Road** that generally follows the Kohrs "Big" Ditch on the west side of the ranch (see Photo 3-5-10). This road intersects with MTSR 4691 just outside of the park boundary. The road surface is dirt/gravel and approximately 10-12 feet wide. Just to the north of the Jensen hay-stacker, this road ends at a gate and continues on the western side of the park boundary fence. Just before the gate, a road branches off to the east and abruptly dead-ends where the unnamed gulch has eroded the road bed and made vehicular passage impassible (see Photo 3-5-11).

Another north-south service road, the **Warren Pumphouse Road** (see Photo 3-5-12), is located just to the west of the railroad corridor, and defines the eastern boundary of the L-Barn field before turning west near the Warren pumphouse (HS-86). Here it continues through North Field before terminating at the southern fence line of the Olson property. This road is dirt/gravel and approximately 10 feet wide.

The **Sewage Treatment Service Road,** (see Photo 3-5-13) is accessed off of Business Loop 90, at the northeastern corner of the NPS property line. This road passes along the northern edge of Front Field, over the railroad corridor, and through the Olson property before passing over the Kohrs-Manning Ditch. Before reaching the north edge of the treatment ponds, a short southern spur provides access along the ditch in Treatment Pond Field. The service road loops around each of the treatment cells and traverses the edge of the Clark Fork River and wetland (old treatment pond) to the south. This road is an approximately 10 foot wide gravel surface.

The Kohrs-Manning Ditch Road and the Clark Fork River Bridge Road are described in the Home Ranch Complex component landscape.

Views and Vistas
[see Map EC-25,26 at the end of this section]

Views within and around the pastures and hayfields are fairly diverse. Views within the Front Fields are fairly contained by the vegetation found along the barrow pits and railroad corridor, and open along the eastern side with views to residential development outside the park boundary. Views of the Continental Divide are fairly prominent from this area. Views are also fairly contained within the Lower Yard Fields, North Meadows, and Stuart Field (which is relatively enclosed by the riparian woodlands of Cottonwood Creek, Johnson Creek, and the Clark Fork River, as well as by the raised elevation of the railroad corridor). Within these fields, as within the other fields located along the eastern side of the river, views of the western foothills and the Flint Creek Mountain Range are very prominent and dominate the western viewshed.

Within the pastures and hayfields located along the western side of the river, views are oriented more towards the east and south. The riparian corridor, river, and home ranch complex add texture, scale, and diversity to the scene. From these fields, the home ranch complex appears relatively small in comparison to the larger context. The Hillcrest Cemetery (particularly the trees contained within it) also becomes a focal point, as do the cluster of buildings along the western edge of Deer Lodge. The steeper topography of the western foothills also act as a dramatic backdrop to this area. The mountains of the Flint Creek Range are generally not visible from the western hay fields. From the higher elevations, views of the sewage treatment ponds are visible.

Buildings and Structures
[see Map EC-19,20 at the end of this section]

The **Jensen Hay-Stacker** (see Photo 3-5-14) is a wood frame structure measuring approximately 30 feet high. Its approximate 12 foot square base is constructed of four posts that are bolted into two braced timber leg supports that provide stability to the structure. Each of the four posts is joined together at a pivot point approximately 15 feet off the ground. Here a triangular beam is attached, supported by a pulley system. It is believed that this structure was loaded with loose hay at the base of the lever, which was then lifted to the top of the stack via the pulley system. The stacker was used with a net—the swing arm moved the net that was then tripped, and dumped hay on the pile. This structure was left in place ca. 1940. It is in a bad state of disrepair, with conservation and relocation to Stuart Field planned for 2004.

Objects and Small-scale Features
[see Map EC-27,28 at the end of this section]

Fences and gates within this component landscape divide space and prevent access and escape by cattle and horses. To serve these purposes, fences and gates are utilitarian in design.

Jack-Leg fence, (see Photo 3-5-15) is found closer to the developed and interpreted areas of the ranch; the southeastern portion of the CLR study boundary. This fence type is similar to other Jack-Leg fences found throughout the CLR study boundary. Two wood posts are crossed at the top to form an X-shape. One horizontal rail rests in the crux of the X while 3 more rails are attached to the exterior of one post to form an angled fence. A fifth rail is attached to the lower side of the opposite pole for added strength and security. All wood members of the fence are un-milled and unfinished.

The two most prominent types of fence within this component landscape are the **Metal Post and Wire fence,** (see Photo 3-5-13) and the **Wood Post and Wire fence.** These fences consist of either thin metal posts or round wood posts, milled and un-milled, that support five (or sometime six) strands of barbed wire. A variation of these fence types combines both wood brace posts and metal posts that support the barbed wire strands. These fences are found further away from the developed areas, where historical accuracy is less important than utility and efficiency. Often times, this fence is referred to as "NPS Cross Fence." Cross fences are associated with function rather than design or materials. They are used to sub-divide a large field or pasture and are generally used to keep cattle from concentrating in one area, resulting in overgrazing or damage to the resource. Cross fencing forces the cattle to remain in other areas to graze.

Several variations of post and rail fence are also within the Pasture/Hay Field. A **4-rail Stacked-end fence,** (see Photo 3-5-16) can be found within the North Field. Four round rails extend between log posts on one side of the fence while two more rails are placed on the lower half of the fence on the other side. At each post, the rails for one section are placed alternately with the rails for the next section, creating a stacked appearance. This fence can also be found with 5 or 6 rails and varying rail and post size.

Woven wire fence is also found throughout the Pasture/Hay Field area. In general, the fence consists of un-milled wood posts or peeled logs supporting a wire mesh component. Variations of this fence type include metal posts or a combination of wood and metal posts supporting wire mesh. Sheep Wire fence is commonly referred to as woven wire fence. This fence is common

throughout the ranch. It is bundled in a large roll and when stretched, it has a strong wire top and bottom. Wire squares are larger on top and smaller on the bottom.

Gates provide access for humans and vehicles along the fence lines, and are also used to move cattle to various pastures and barns. **Overhead Gates,** (see Photo 3-5-15) have two tall, vertical posts supporting a top-mounted horizontal crossbar. These overhead gates were meant to support swinging gates, but many are missing at present. An example of overhead gates in this landscape is found in the southeast corner of the CLR study boundary, west of the railroad tracks and stream.

A second type of gate, part of the overhead gate given as the example above, is the **Double 5-rail Braced Gate** (see Photo 3-5-15). These gates, which swing open at the center, have hinge-posts almost twice the height of the gate and have long, diagonal braces leading from the top of the hinge-posts to the opposite corner of the gates. This brace prevents and corrects sagging.

Metal Pipe Gates, (see Photo 3-5-16) are located north of the haystacker, along the western edge of the CLR study boundary, and in the front fields. These gates are constructed of welded metal pipes and swing open from a hinge-post. The front fields also have **Metal Pipe and Mesh Gates,** (see Photo 3-5-17) that consist of welded metal pipe frames supporting welded wire mesh. Blue plastic **watering troughs,** (see Photo 3-5-16) are located along fence lines within the North Fields. These features measure approximately 8' in diameter and two feet deep. Installed at the same time this field was sub-divided with cross-fencing (ca. 1999), they are used to provide water for the livestock in the fields.

Missing & Archeological Resources
[see Map EC-27, 28 at the end of this section]

The **ruins** of a wood frame structure are located in the Western Hay Fields. (see Photo 3-5-18). These ruins are remnants of old hay panels, which were placed around stacks of hay to keep livestock out. It appears as those this structure collapsed many years ago and has been deteriorating for some time.

According to NPS personnel, a **small hill** was once located in the hay fields. This hill was made up of earth that was removed ca.1988 from a knob in Big Gulch to grade the Clark Fork River Bridge Road bed.

JMA, October 2002

Photo 3-5-1 : (F-07) An unnamed gulch feeds into the Kohrs-Manning Ditch.

JMA, October 2002

Photo 3-5-2 : (G-07) Major hay grasses found in the irrigated hay fields and meadows along the riparian zone are non-native species.

JMA, October 2002

Photo 3-5-3 : (RE-20) Stuart Field in the distance.

JMA, October 2002

Photo 3-5-4 : (G-01) North Meadows.

JMA, October 2002

Photo 3-5-5 : (L-02) The Kohrs “Big” Ditch.

JMA, October 2002

Photo 3-5-6 : (K-24) Typical Wooden Headgate with Wooden Distribution Gate.

JMA, October 2002

Photo 3-5-7 : (L-21) Typical Concrete Headgate.

JMA, October 2002

Photo 3-5-8 : (M-24) Distribution Gate.

JMA, October 2002

Photo 3-5-9 : (L-19) Exposed Culvert.

JMA, October 2002

Photo 3-5-10 : (M-13) Kohrs Ditch Road.

JMA, October 2002

Photo 3-5-11 : (K-04) Erosion at end of unnamed gulch on the west side of the ranch.

JMA, October 2002

Photo 3-5-12 : (F-03) Warren Pumphouse Road.

JMA, October 2002

Photo 3-5-13 : (J-10) Sewage Treatment Service Road. Wood Post and Wire Fence (left); Metal Post and Wire Fence (right).

JMA, October 2002

Photo 3-5-14 : (L-24) Jensen Hay Stacker. Wood Post and Wire Fence in background.

JMA, October 2002

Photo 3-5-15 : (R-03) Jack-Leg Fence with Overhead Gates and Double 5-Rail Braced Gates.

JMA, October 2002

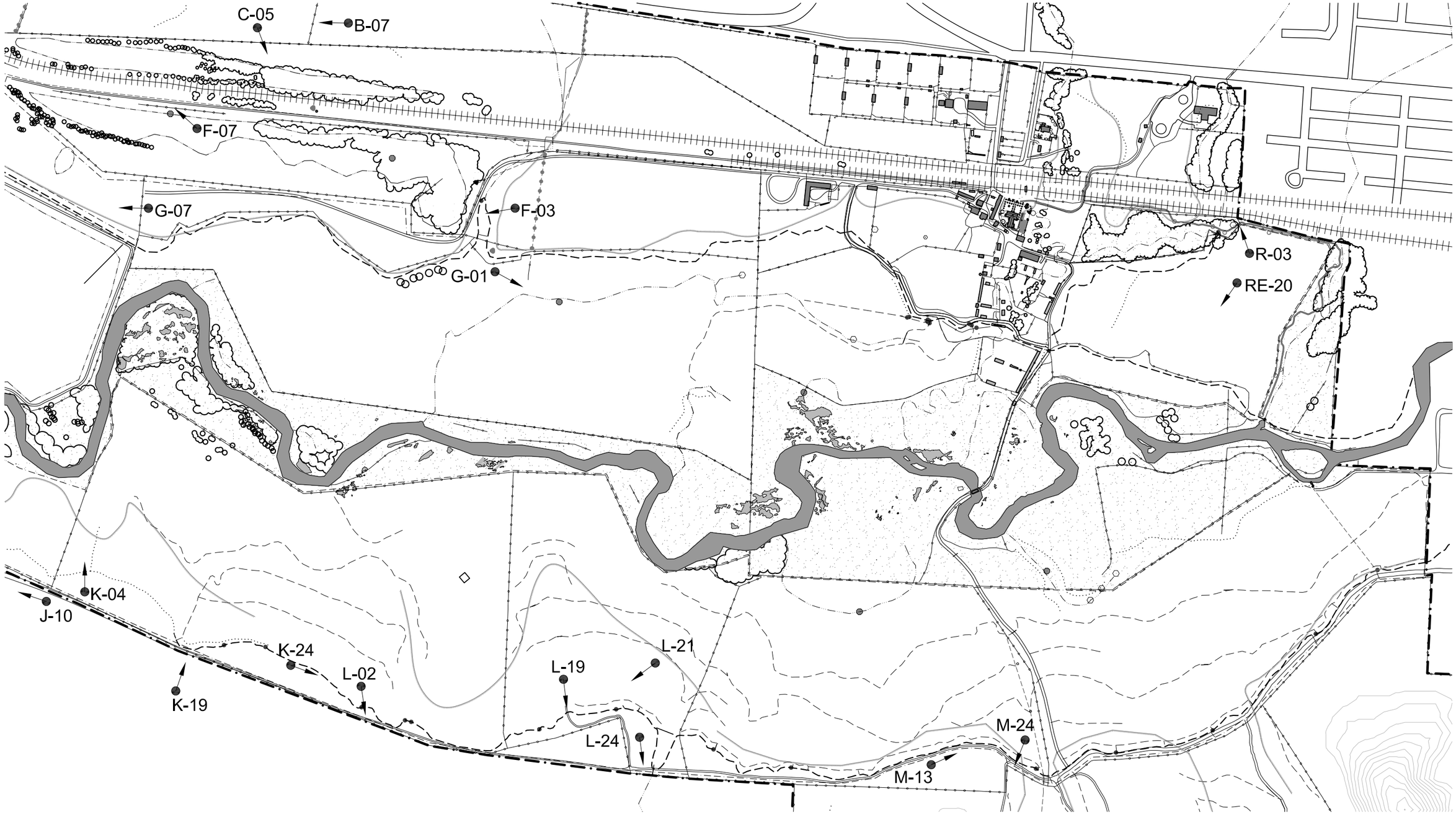
Photo 3-5-16 : (B-07) Metal Post and Wire Fence and Metal Pipe Gate (right). 4-Rail Stacked End Fence and watering trough (left).

JMA, October 2002

Photo 3-5-17 : (C-05) Metal Pipe and Mesh Gate (left). Wood Post and Wire Gate and Metal Post and Wire fence (right).

JMA, October 2002

Photo 3-5-18 : (K-19) Ruins of hay panels.



Map Sources: Base mapping referenced to Grant-Kohrs Ranch National Historic Site 1994 aerial photographs and Montana 1:24,000 scale State Plane DRG quadrangles. GIS data was exported into Autocad format for production of base maps and further further detailed with additional data collected in the field.

The following data was provided by the National Park Service, Grant-Kohrs Ranch National Historic Site GIS Program (shapefile format), which was compiled 1998 and updated/field-checked by OCULUS/JMA during the October 2002 site visit: fences and gates; boundary lines; utility lines; fire hydrants; irrigation ditches, headgates, pipes, and risers; culverts; river boundaries; roads; railroad tracks; unvegetated slickens and tailings; fields; trails; cottonwood trees; beaver lodges and dams; hydrology; and groundwater monitoring wells. Metadata for this data is avaliable from World Wide Web: [http://www.nps.gov/gis/metadata/grko/]. Wetlands, hypsography (topography), and Montana 1:24,000 scale State Plane DRG quadrangles were derived from Montana State Library Natural Resource Information System, metadata available from: [http://nris.state.mt.us/gis/datalist.html].

Legend:

- Roads
- Vegetation
- Bench
- Fences
- Streams/Sloughs
- Railroad
- Buildings/ Structures
- Springs
- Old Ditches
- Main Ditches
- Lateral Ditches
- Component Landscape Boundary Line
- GRKO Boundary Line
- Beaver Lodges

Scale: 1" = 600'

A/E FIRM

PRIME
NAME: Susan Maxman Architects
CITY, STATE: Philadelphia, PA

SUBCONTRACTOR
NAME: John Milner Associates, Inc.
CITY, STATE: Charlottesville, VA

DESIGNED:
DRAWN: ADF
TECH. REVIEW: KLS, RMM
DATE: JULY 2004

SUB SHEET NO. P-7

EXISTING CONDITIONS INVENTORY MAP

PASTURE/HAYFIELDS

PHOTO STATION POINT MAP

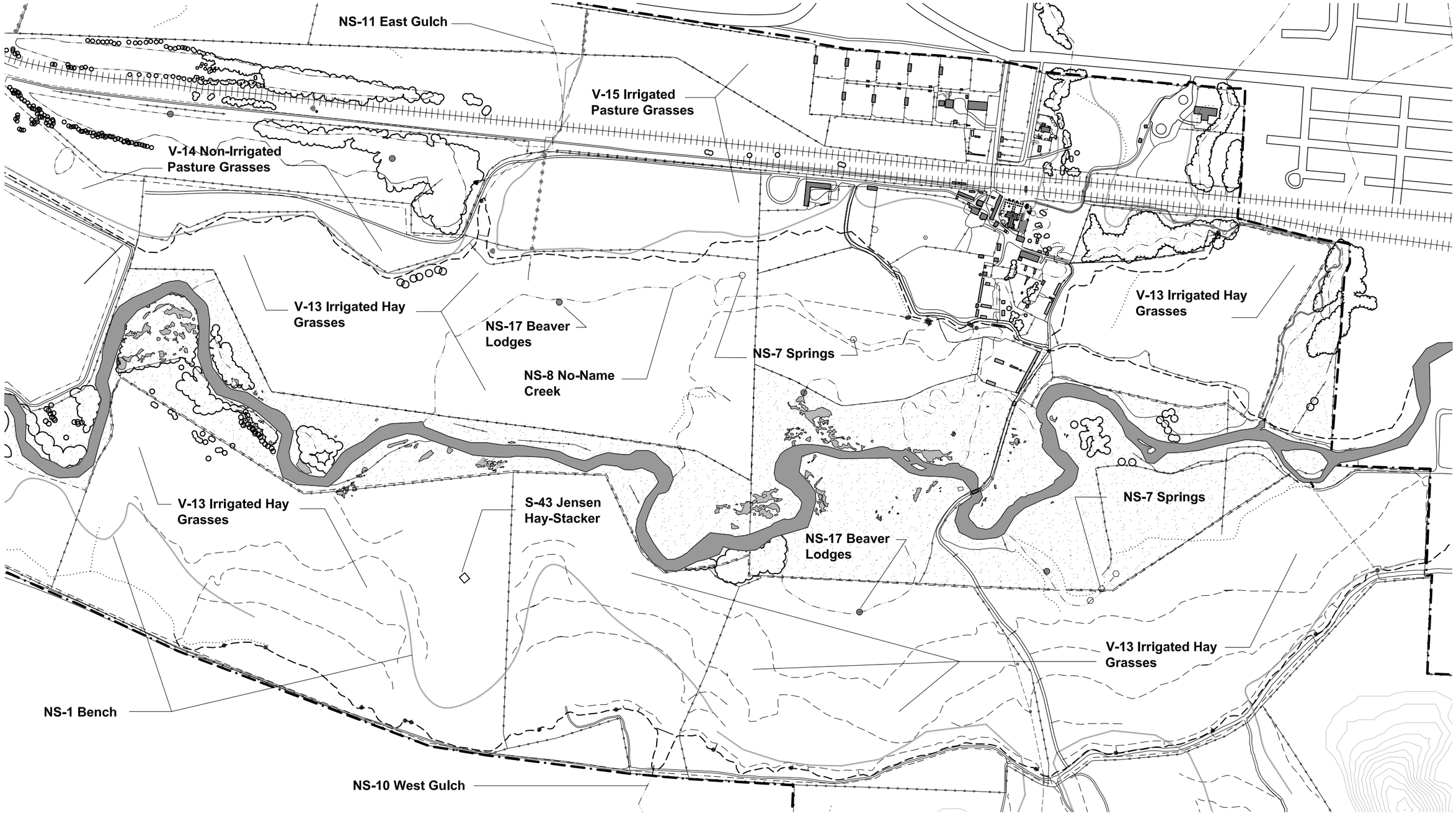
GRANT-KOHRS RANCH NATIONAL HISTORIC SITE

DRAWING NO.

PKG. NO.

SHEET

OF



Map Sources: Base mapping referenced to Grant-Kohrs Ranch National Historic Site 1994 aerial photographs and Montana 1:24,000 scale State Plane DRG quadrangles. GIS data was exported into Autocad format for production of base maps and further further detailed with additional data collected in the field.

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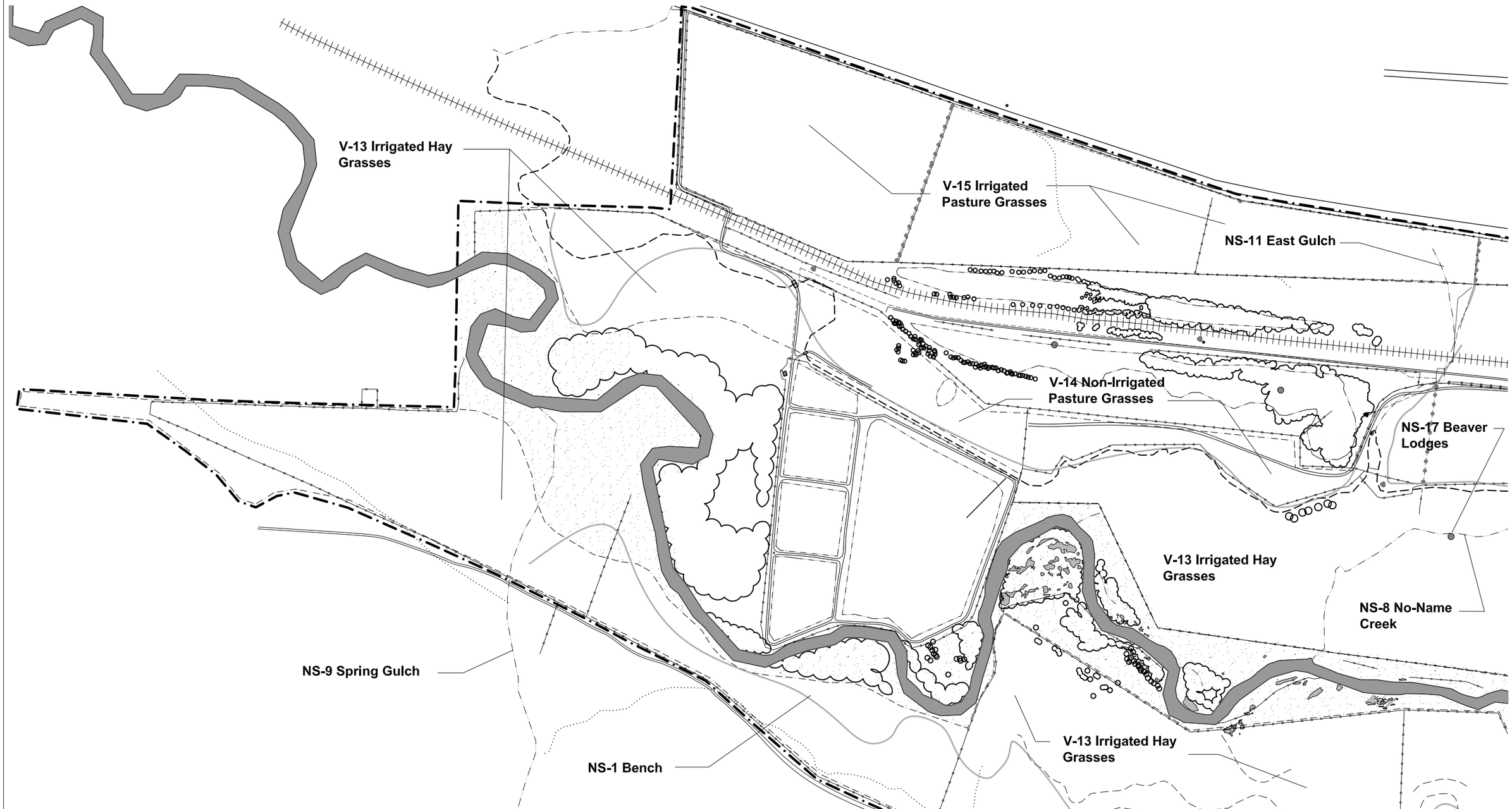
Legend:

- Roads
- Vegetation
- Bench
- Fences
- Streams/Sloughs
- Railroad
- Buildings/ Structures
- Springs
- Old Ditches
- Main Ditches
- Lateral Ditches
- Component Landscape Boundary Line
- GRKO Boundary Line
- Beaver Lodges

Scale: 1" = 600'

A/E FIRM PRIME NAME: Susan Maxman Architects CITY, STATE: Philadelphia, PA SUBCONTRACTOR NAME: John Milner Associates, Inc. CITY, STATE: Charlottesville, VA	DESIGNED: DRAWN: JLB, WMW TECH. REVIEW: KLS, RMM DATE: JULY 2004	SUB SHEET NO. EC-19	EXISTING CONDITIONS INVENTORY MAP PASTURE/HAYFIELDS SOUTH **NATURAL SYSTEMS, VEGETATION, BUILDINGS & STRUCTURES** GRANT-KOHRS RANCH NATIONAL HISTORIC SITE	DRAWING NO. PKG. NO. SHEET OF



Map Sources: Base mapping referenced to Grant-Kohrs Ranch National Historic Site 1994 aerial photographs and Montana 1:24,000 scale State Plane DRG quadrangles. GIS data was exported into Autocad format for production of base maps and further further detailed with additional data collected in the field.

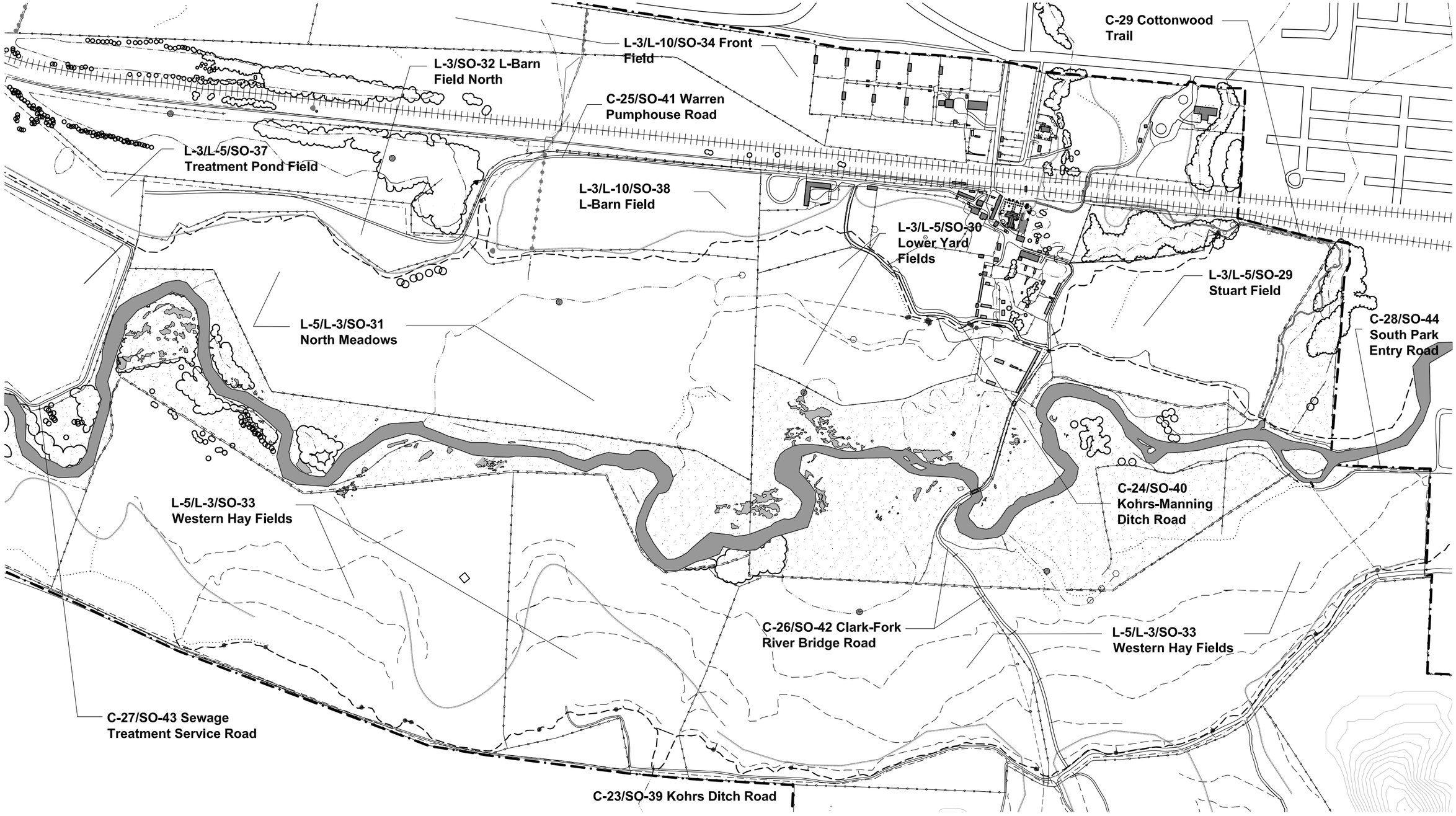
The following data was provided by the National Park Service, Grant-Kohrs Ranch National Historic Site GIS Program (shapefile format), which was compiled 1998 and updated/field-checked by OCULUS/JMA during the October 2002 site visit: fences and gates; boundary lines; utility lines; fire hydrants; irrigation ditches, headgates, pipes, and risers; culverts; river boundaries; roads; railroad tracks; unvegetated slickens and tailings; fields; trails; cottonwood trees; beaver lodges and dams; hydrology; and groundwater monitoring wells. Metadata for this data is avaliable from World Wide Web: [http://www.nps.gov/gis/metadata/grko/]. Wetlands, hypsography (topography), and Montana 1:24,000 scale State Plane DRG quadrangles were derived from Montana State Library Natural Resource Information System, metadata available from: [http://nris.state.mt.us/gis/datalist.html].

Legend:

- Roads
- Vegetation
- Bench
- Fences
- Streams/Sloughs
- Railroad
- Buildings/ Structures
- Springs
- Old Ditches
- Main Ditches
- Lateral Ditches
- Component Landscape Boundary Line
- GRKO Boundary Line
- Beaver Lodges

Scale: 1" = 600'

A/E FIRM PRIME NAME: Susan Maxman Architects CITY, STATE: Philadelphia, PA SUBCONTRACTOR NAME: John Milner Associates, Inc. CITY, STATE: Charlottesville, VA	DESIGNED: DRAWN: JLB, WMW TECH. REVIEW: KLS, RMM DATE: JULY 2004	SUB SHEET NO. EC-20	EXISTING CONDITIONS INVENTORY MAP PASTURE/HAYFIELDS NORTH **NATURAL SYSTEMS, VEGETATION, BUILDINGS & STRUCTURES** GRANT-KOHRS RANCH NATIONAL HISTORIC SITE	DRAWING NO. PKG. NO. SHEET OF



Map Sources: Base mapping referenced to Grant-Kohrs Ranch National Historic Site 1994 aerial photographs and Montana 1:24,000 scale State Plane DRG quadrangles. GIS data was exported into Autocad format for production of base maps and further further detailed with additional data collected in the field.

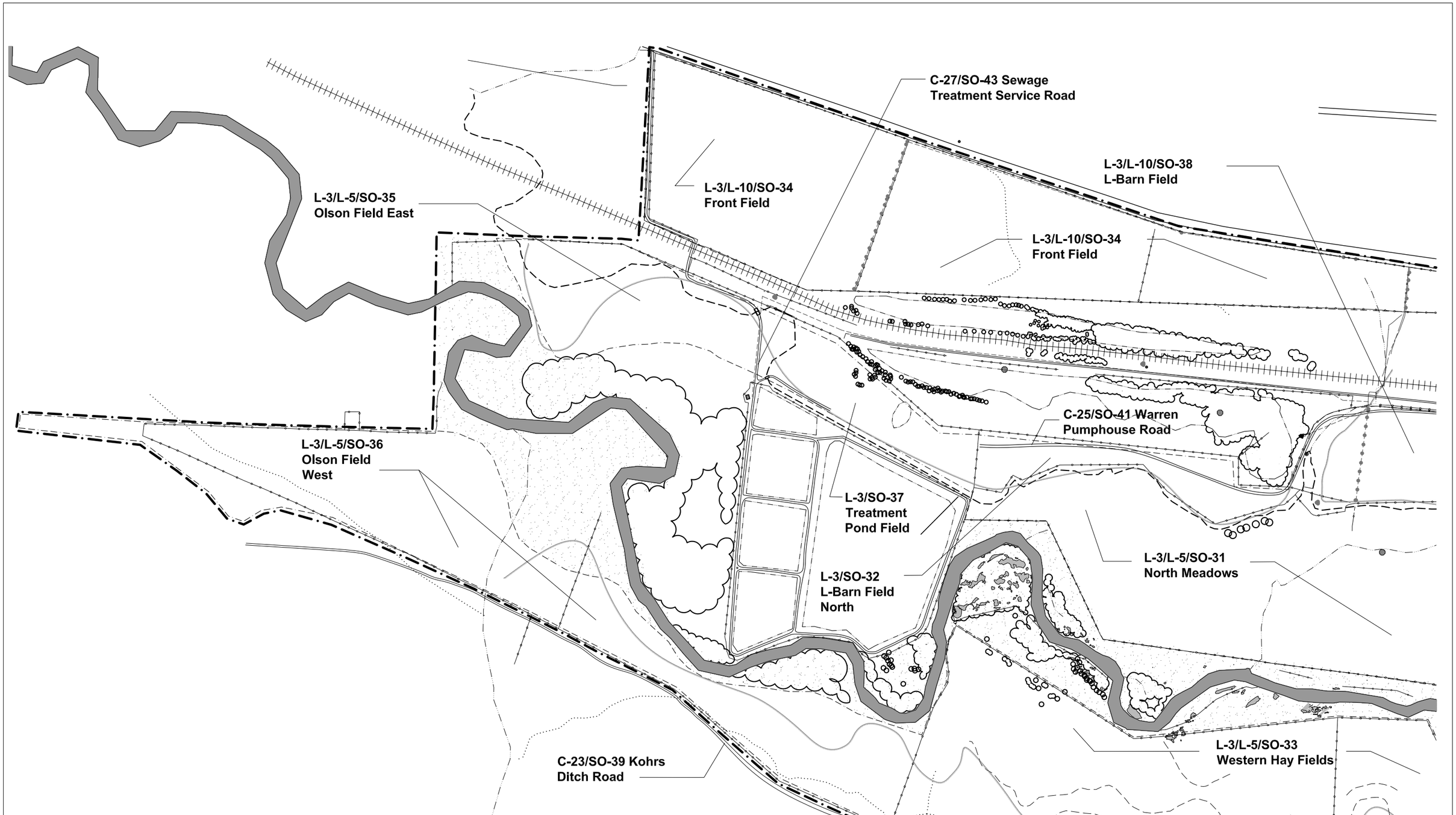
The following data was provided by the National Park Service, Grant-Kohrs Ranch National Historic Site GIS Program (shapefile format), which was compiled 1998 and updated/field-checked by OCULUS/JMA during the October 2002 site visit: fences and gates; boundary lines; utility lines; fire hydrants; irrigation ditches, headgates, pipes, and risers; culverts; river boundaries; roads; railroad tracks; unvegetated slickens and tailings; fields; trails; cottonwood trees; beaver lodges and dams; hydrology; and groundwater monitoring wells. Metadata for this data is avaliable from World Wide Web: [http://www.nps.gov/gis/metadata/grko/]. Wetlands, hypsography (topography), and Montana 1:24,000 scale State Plane DRG quadrangles were derived from Montana State Library Natural Resource Information System, metadata available from: [http://nris.state.mt.us/gis/datalist.html].

Legend:

- Roads
- Vegetation
- Bench
- Fences
- Streams/Sloughs
- Railroad
- Buildings/ Structures
- Springs
- Old Ditches
- Main Ditches
- Lateral Ditches
- Component Landscape Boundary Line
- GRKO Boundary Line
- Beaver Lodges

Scale: 1" = 600'

A/E FIRM PRIME NAME: Susan Maxman Architects CITY, STATE: Philadelphia, PA SUBCONTRACTOR NAME: John Milner Associates, Inc. CITY, STATE: Charlottesville, VA	DESIGNED: DRAWN: JLB, WMW TECH. REVIEW: KLS, RMM DATE: JULY 2004	SUB SHEET NO. EC-21	EXISTING CONDITIONS INVENTORY MAP PASTURE/HAYFIELDS SOUTH **CIRCULATION, SPATIAL ORGANIZATION, AND LAND USE** GRANT-KOHRS RANCH NATIONAL HISTORIC SITE	DRAWING NO. PKG. NO. SHEET OF



Map Sources: Base mapping referenced to Grant-Kohrs Ranch National Historic Site 1994 aerial photographs and Montana 1:24,000 scale State Plane DRG quadrangles. GIS data was exported into Autocad format for production of base maps and further further detailed with additional data collected in the field.

The following data was provided by the National Park Service, Grant-Kohrs Ranch National Historic Site GIS Program (shapefile format), which was compiled 1998 and updated/field-checked by OCULUS/JMA during the October 2002 site visit: fences and gates; boundary lines; utility lines; fire hydrants; irrigation ditches, headgates, pipes, and risers; culverts; river boundaries; roads; railroad tracks; unvegetated slickens and tailings; fields; trails; cottonwood trees; beaver lodges and dams; hydrology; and groundwater monitoring wells. Metadata for this data is avaliable from World Wide Web: [http://www.nps.gov/gis/metadata/grko/]. Wetlands, hypsography (topography), and Montana 1:24,000 scale State Plane DRG quadrangles were derived from Montana State Library Natural Resource Information System, metadata available from: [http://nris.state.mt.us/gis/datalist.html].

Legend:

- Roads
- Vegetation
- Bench
- Fences
- Streams/Sloughs
- Railroad
- Buildings/ Structures
- Springs
- Old Ditches
- Main Ditches
- Lateral Ditches
- Component Landscape Boundary Line
- GRKO Boundary Line
- Beaver Lodges

Scale: 1" = 600'

A/E FIRM PRIME NAME: Susan Maxman Architects CITY, STATE: Philadelphia, PA SUBCONTRACTOR NAME: John Milner Associates, Inc. CITY, STATE: Charlottesville, VA	DESIGNED: DRAWN: JLB, WMW TECH. REVIEW: KLS, RMM DATE: JULY 2004	SUB SHEET NO. EC-22	EXISTING CONDITIONS INVENTORY MAP PASTURE/HAYFIELDS NORTH **CIRCULATION, SPATIAL ORGANIZATION, AND LAND USE** GRANT-KOHRS RANCH NATIONAL HISTORIC SITE	DRAWING NO. PKG. NO. SHEET OF

CW-13/CW-10 Irrigation Mainline and Risers

CW-11 Irrigation Headgates

CW-13 Irrigation Mainline

CW-13 Irrigation Mainline

CW-10 Irrigation Risers

CW-1 Kohrs-Manning Ditch

CW-12 Effluent Well

CW-8 Lateral Ditches

CW-9 Old/Abandoned Ditches

CW-11 Irrigation Headgates

CW-7 Johnson Ditch

CW-1 Kohrs-Manning Ditch

CW-8 Lateral Ditches

CW-9 Old/Abandoned Ditches

CW-13 Irrigation Mainline

CW-13 Irrigation Mainline

CW-11 Irrigation Headgates

CW-11 Irrigation Headgates

CW-15 Culverts

CW-11 Irrigation Headgates

CW-9 Old/Abandoned Ditches

CW-11 Irrigation Headgates

CW-11 Irrigation Headgates

CW-6 Kohrs "Big" Ditch

CW-11 Irrigation Headgates

CW-15 Culverts

CW-6 Kohrs "Big" Ditch

Map Sources: Base mapping referenced to Grant-Kohrs Ranch National Historic Site 1994 aerial photographs and Montana 1:24,000 scale State Plane DRG quadrangles. GIS data was exported into Autocad format for production of base maps and further further detailed with additional data collected in the field.

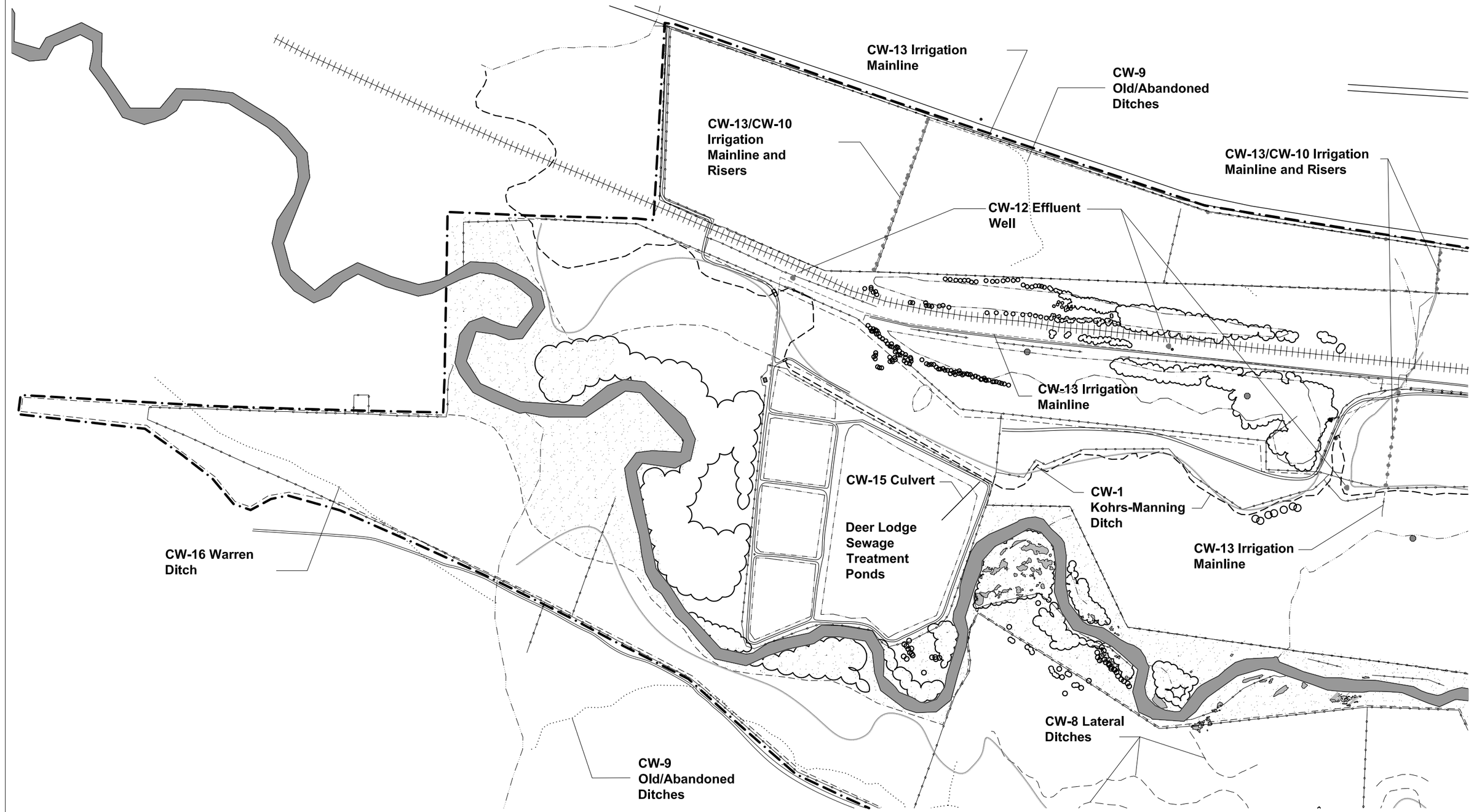
The following data was provided by the National Park Service, Grant-Kohrs Ranch National Historic Site GIS Program (shapefile format), which was compiled 1998 and updated/field-checked by OCULUS/JMA during the October 2002 site visit: fences and gates; boundary lines; utility lines; fire hydrants; irrigation ditches, headgates, pipes, and risers; culverts; river boundaries; roads; railroad tracks; unvegetated slickens and tailings; fields; trails; cottonwood trees; beaver lodges and dams; hydrology; and groundwater monitoring wells. Metadata for this data is avaliable from World Wide Web: [http://www.nps.gov/gis/metadata/grko/]. Wetlands, hypsography (topography), and Montana 1:24,000 scale State Plane DRG quadrangles were derived from Montana State Library Natural Resource Information System, metadata available from: [http://nris.state.mt.us/gis/datalist.html].

Legend:

- Roads
- Vegetation
- Bench
- Fences
- Streams/Sloughs
- Railroad
- Buildings/ Structures
- Springs
- Old Ditches
- Main Ditches
- Lateral Ditches
- Component Landscape Boundary Line
- GRKO Boundary Line
- Beaver Lodges

Scale: 1" = 600'

A/E FIRM PRIME NAME: Susan Maxman Architects CITY, STATE: Philadelphia, PA SUBCONTRACTOR NAME: John Milner Associates, Inc. CITY, STATE: Charlottesville, VA	DESIGNED: DRAWN: JLB, WMW TECH. REVIEW: KLS, RMM DATE: JULY 2004	SUB SHEET NO. EC-23	EXISTING CONDITIONS INVENTORY MAP PASTURE/HAYFIELDS SOUTH **CONSTRUCTED WATER FEATURES** GRANT-KOHRS RANCH NATIONAL HISTORIC SITE	DRAWING NO. PKG. NO. SHEET OF



Map Sources: Base mapping referenced to Grant-Kohrs Ranch National Historic Site 1994 aerial photographs and Montana 1:24,000 scale State Plane DRG quadrangles. GIS data was exported into Autocad format for production of base maps and further further detailed with additional data collected in the field.

The following data was provided by the National Park Service, Grant-Kohrs Ranch National Historic Site GIS Program (shapefile format), which was compiled 1998 and updated/field-checked by OCULUS/JMA during the October 2002 site visit: fences and gates; boundary lines; utility lines; fire hydrants; irrigation ditches, headgates, pipes, and risers; culverts; river boundaries; roads; railroad tracks; unvegetated slickens and tailings; fields; trails; cottonwood trees; beaver lodges and dams; hydrology; and groundwater monitoring wells. Metadata for this data is avaliable from World Wide Web: [http://www.nps.gov/gis/metadata/grko/]. Wetlands, hypsography (topography), and Montana 1:24,000 scale State Plane DRG quadrangles were derived from Montana State Library Natural Resource Information System, metadata available from: [http://nris.state.mt.us/gis/datalist.html].

Legend:

- Roads
- Vegetation
- Bench
- Fences
- Streams/Sloughs
- Railroad
- Buildings/ Structures
- Springs
- Old Ditches
- Main Ditches
- Lateral Ditches
- Component Landscape Boundary Line
- GRKO Boundary Line
- Beaver Lodges

Scale: 1" = 600'

A/E FIRM

PRIME
NAME: Susan Maxman Architects
CITY, STATE: Philadelphia, PA

SUBCONTRACTOR
NAME: John Milner Associates, Inc.
CITY, STATE: Charlottesville, VA

DESIGNED:

DRAWN: JLB, WMW

TECH. REVIEW: KLS, RMM

DATE: JULY 2004

SUB SHEET NO. EC-24

EXISTING CONDITIONS INVENTORY MAP

PASTURE/HAYFIELDS NORTH

CONSTRUCTED WATER FEATURES

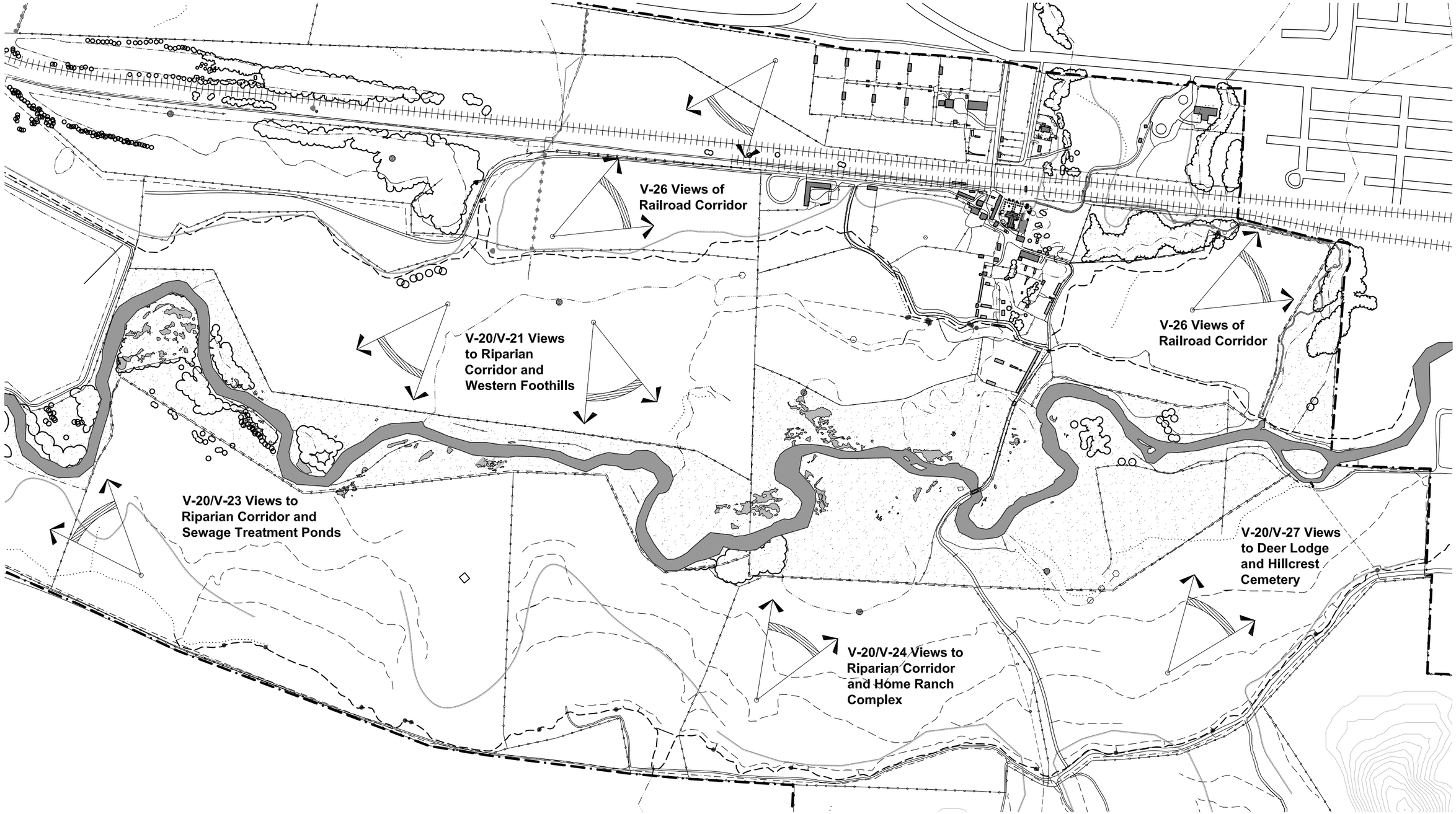
GRANT-KOHRS RANCH NATIONAL HISTORIC SITE

DRAWING NO.

PKG. NO.

SHEET

OF



Map Sources: Base mapping referenced to Grant-Kohrs Ranch National Historic Site 1994 aerial photographs and Montana 1:24,000 scale State Plane DRG quadrangles. GIS data was exported into Autocad format for production of base maps and further further detailed with additional data collected in the field.

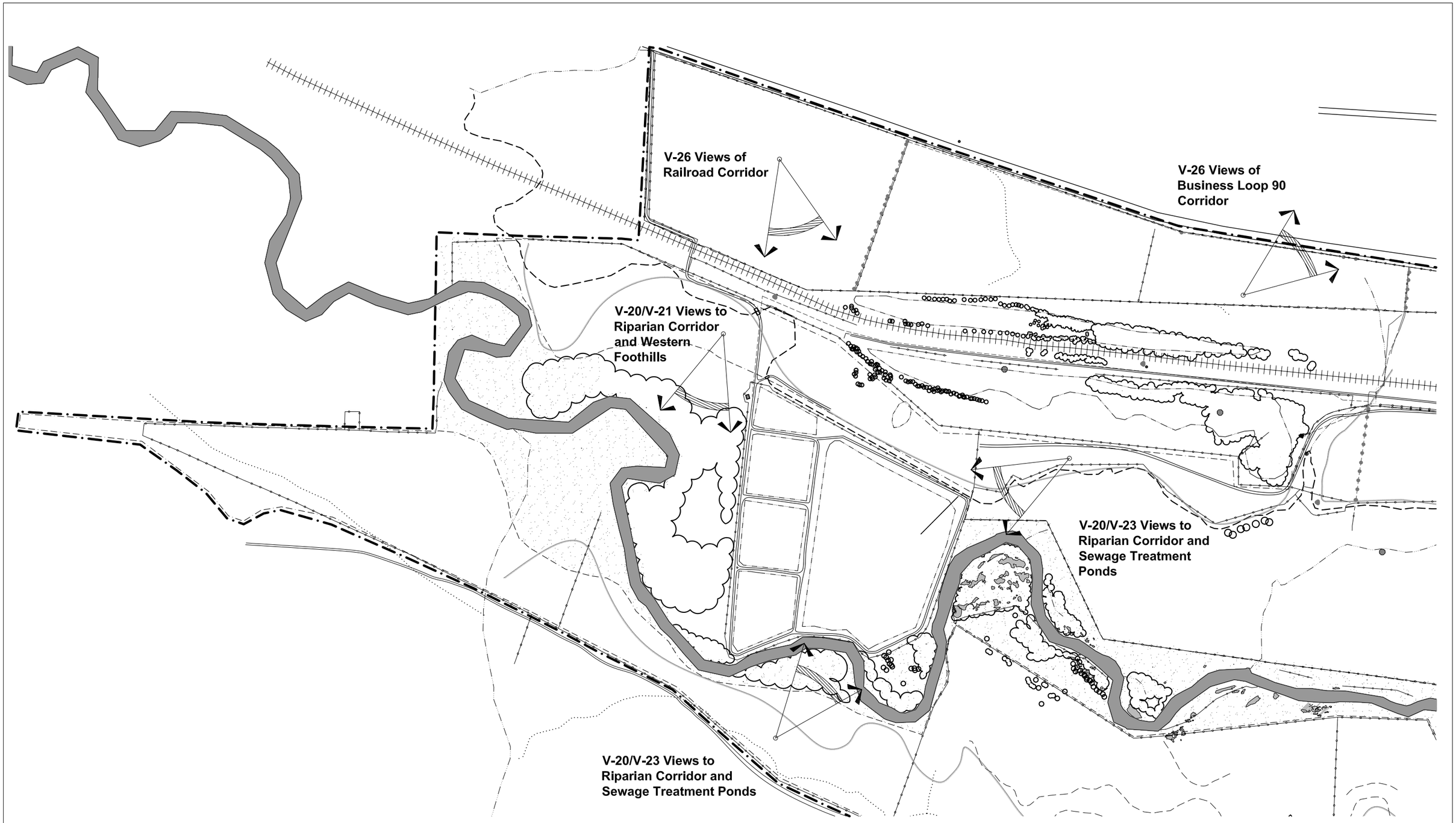
The following data was provided by the National Park Service, Grant-Kohrs Ranch National Historic Site GIS Program (shapefile format), which was compiled 1998 and updated/field-checked by OCULUS/JMA during the October 2002 site visit: fences and gates; boundary lines; utility lines; fire hydrants; irrigation ditches, headgates, pipes, and risers; culverts; river boundaries; roads; railroad tracks; unvegetated slickens and tailings; fields; trails; cottonwood trees; beaver lodges and dams; hydrology; and groundwater monitoring wells. Metadata for this data is avaliable from World Wide Web: [http://www.nps.gov/gis/metadata/grko/]. Wetlands, hypsography (topography), and Montana 1:24,000 scale State Plane DRG quadrangles were derived from Montana State Library Natural Resource Information System, metadata available from: [http://nris.state.mt.us/gis/datalist.html].

Legend:

- Roads
- Vegetation
- Bench
- Fences
- Streams/Sloughs
- Railroad
- Buildings/ Structures
- Springs
- Old Ditches
- Main Ditches
- Lateral Ditches
- Component Landscape Boundary Line
- GRKO Boundary Line
- Beaver Lodges

Scale: 1" = 600'

A/E FIRM PRIME NAME: Susan Maxman Architects CITY, STATE: Philadelphia, PA SUBCONTRACTOR NAME: John Milner Associates, Inc. CITY, STATE: Charlottesville, VA	DESIGNED: DRAWN: JLB, WMW TECH. REVIEW: KLS, RMM DATE: JULY 2004	SUB SHEET NO. EC-25	EXISTING CONDITIONS INVENTORY MAP PASTURE/HAYFIELDS SOUTH **VIEWS** GRANT-KOHRS RANCH NATIONAL HISTORIC SITE	DRAWING NO. PKG. NO. SHEET OF



Map Sources: Base mapping referenced to Grant-Kohrs Ranch National Historic Site 1994 aerial photographs and Montana 1:24,000 scale State Plane DRG quadrangles. GIS data was exported into Autocad format for production of base maps and further further detailed with additional data collected in the field.

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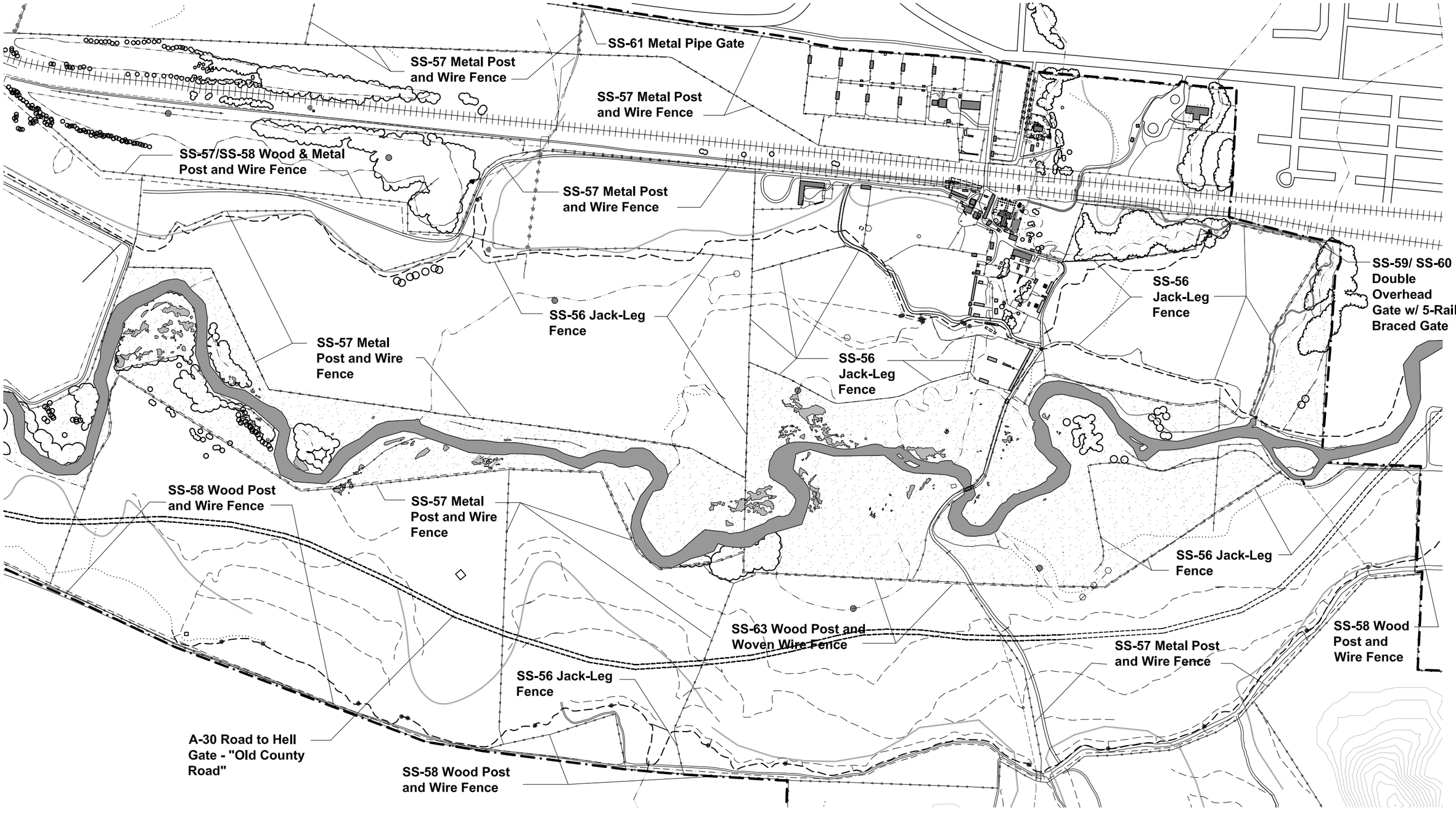
Legend:

- Roads
- Vegetation
- Bench
- Fences
- Streams/Sloughs
- Railroad
- Buildings/ Structures
- Springs
- Old Ditches
- Main Ditches
- Lateral Ditches
- Component Landscape Boundary Line
- GRKO Boundary Line
- Beaver Lodges

Scale: 1" = 600'

A/E FIRM PRIME NAME: Susan Maxman Architects CITY, STATE: Philadelphia, PA SUBCONTRACTOR NAME: John Millner Associates, Inc. CITY, STATE: Charlottesville, VA	DESIGNED: DRAWN: JLB, WMW TECH. REVIEW: KLS, RMM DATE: JULY 2004	SUB SHEET NO. EC-26	EXISTING CONDITIONS INVENTORY MAP PASTURE/HAYFIELDS NORTH **VIEWS** GRANT-KOHRS RANCH NATIONAL HISTORIC SITE	DRAWING NO. PKG. NO. SHEET OF



Map Sources: U. S. Surveyor's General Office. Plat of Township 8 North, Range 9 West of the Principal Meridian, Montana. W. W. Johnson, October 1868. Billings: Bureau of Land Management; Base mapping referenced to Grant-Kohrs Ranch National Historic Site 1994 aerial photographs and Montana 1:24,000 scale State Plane DRG quadrangles. GIS data was exported into Autocad format for production of base maps and further further detailed with additional data collected in the field.

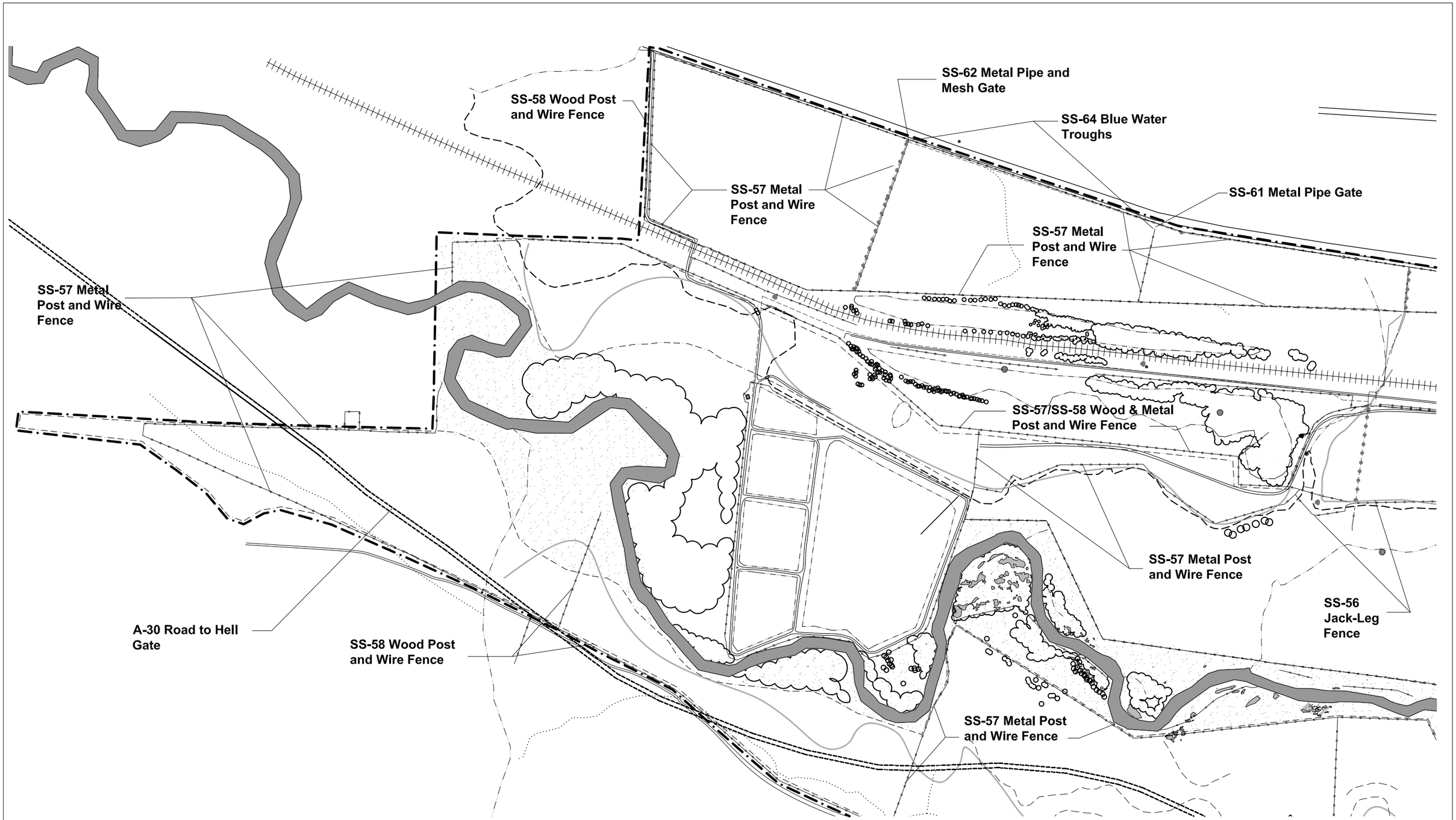
The following data was provided by the National Park Service, Grant-Kohrs Ranch National Historic Site GIS Program (shapefile format), which was compiled 1998 and updated/field-checked by OCULUS/JMA during the October 2002 site visit: fences and gates; boundary lines; utility lines; fire hydrants; irrigation ditches, headgates, pipes, and risers; culverts; river boundaries; roads; railroad tracks; unvegetated slickens and tailings; fields; trails; cottonwood trees; beaver lodges and dams; hydrology; and groundwater monitoring wells. Metadata for this data is avaliable from World Wide Web: [http://www.nps.gov/gis/metadata/grko/]. Wetlands, hypsography (topography), and Montana 1:24,000 scale State Plane DRG quadrangles were derived from Montana State Library Natural Resource Information System, metadata available from: [http://nris.state.mt.us/gis/datalist.html].

Legend:

- Roads
- Vegetation
- Bench
- Fences
- Streams/Sloughs
- Railroad
- Buildings/ Structures
- Springs
- Old Ditches
- Main Ditches
- Lateral Ditches
- Component Landscape Boundary Line
- GRKO Boundary Line
- Beaver Lodges

Scale: 1" = 600'

A/E FIRM PRIME NAME: Susan Maxman Architects CITY, STATE: Philadelphia, PA SUBCONTRACTOR NAME: John Milner Associates, Inc. CITY, STATE: Charlottesville, VA	DESIGNED: DRAWN: JLB, WMW TECH. REVIEW: KLS, RMM DATE: JULY 2004	SUB SHEET NO. EC-27	EXISTING CONDITIONS INVENTORY MAP PASTURE/HAYFIELDS SOUTH **OBJECTS, SMALL SCALE, & MISSING FEATURES** GRANT-KOHRS RANCH NATIONAL HISTORIC SITE	DRAWING NO. PKG. NO. SHEET OF



Map Sources: U. S. Surveyor's General Office. Plat of Township 8 North, Range 9 West of the Principal Meridian, Montana. W. W. Johnson, October 1868. Billings: Bureau of Land Management; Base mapping referenced to Grant-Kohrs Ranch National Historic Site 1994 aerial photographs and Montana 1:24,000 scale State Plane DRG quadrangles. GIS data was exported into Autocad format for production of base maps and further further detailed with additional data collected in the field.

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Legend:

- Roads
- Vegetation
- Bench
- Fences
- Streams/Sloughs
- Railroad
- Buildings/ Structures
- Springs
- Old Ditches
- Main Ditches
- Lateral Ditches
- Component Landscape Boundary Line
- GRKO Boundary Line
- Beaver Lodges

Scale: 1" = 600'

A/E FIRM

PRIME
NAME: Susan Maxman Architects
CITY, STATE: Philadelphia, PA

SUBCONTRACTOR
NAME: John Milner Associates, Inc.
CITY, STATE: Charlottesville, VA

DESIGNED:

DRAWN: JLB, WMW

TECH. REVIEW: KLS, RMM

DATE: JULY 2004

SUB SHEET NO. EC-28

EXISTING CONDITIONS INVENTORY MAP

PASTURE/HAYFIELDS NORTH

OBJECTS, SMALL SCALE, & MISSING FEATURES

GRANT-KOHRS RANCH NATIONAL HISTORIC SITE

DRAWING NO.

PKG. NO.

SHEET

OF